

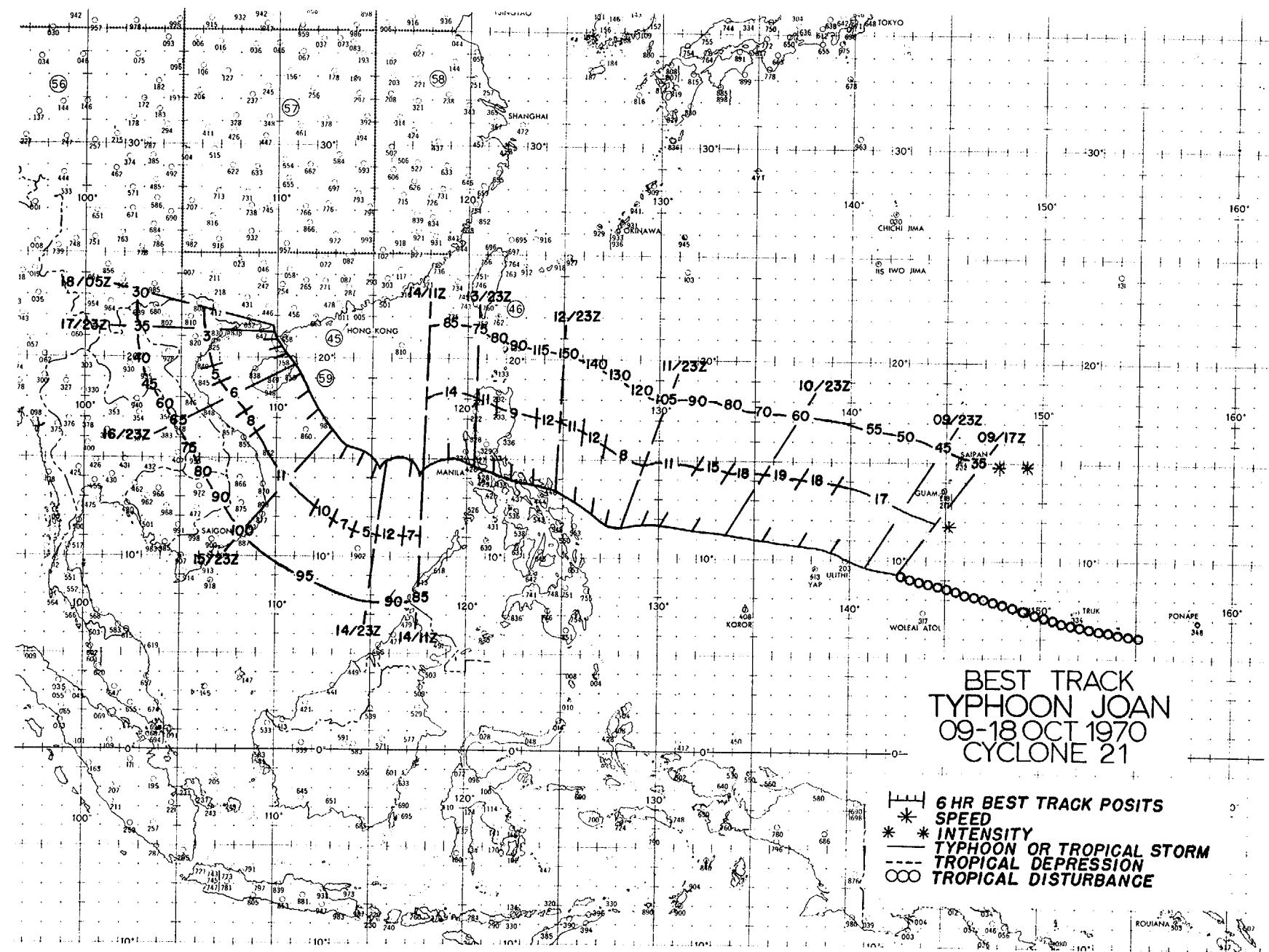
J. TYPHOON JOAN 09 OCT 2300Z-18 OCT 0500Z

1. STATISTICS

- a. Number of Warnings Issued - 34
- b. Number of Warnings with Typhoon Intensity - 25
- c. Distance Traveled During Warning Period - 2,254 MI

2. CHARACTERISTICS AS A TYPHOON

- a. Minimum Observed SLP - 901 MBS at 12/2100Z
- b. Minimum Observed 700 MB Height - 2332 M at 12/2100Z
- c. Maximum Surface Wind - 150 KTS (From Best Track)
- d. Maximum Radius of Surface Circulation - 720 MI



3. TYPHOON JOAN NARRATIVE

Joan was the first of two sister super typhoons to strike the Republic of the Philippines within a period of a week.

The disturbance which was to become Joan entered on stage in the Truk-Ponape area of the Caroline Islands on the 8th of October. Upper air data revealed the existence of a 200 mb circulation two days earlier and by the 8th a downward reflection of the system appeared as a wave in the surface pressure pattern. Meanwhile, the subtropical ridge was strengthening, producing a tightening pressure gradient and resulting in favorable relative vorticity pattern for increasing mass inflow into the system. As a consequence of the strong easterly trades the wave disturbance began a westward movement of 17 knots. A surface circulation developed by the morning of the 9th and that afternoon, Joan passed Ulithi Atoll having reached tropical storm force.

Upon achieving typhoon intensity by noon the 11th, the storm's forward speed reduced to 11 knots while it moved within the southern periphery of a 200 mb anticyclone situated 300 miles southeast of Okinawa. In response to the increasing divergence pattern aloft, the central pressure began to drop steadily from 976 to 924 mb by late the following afternoon. As Joan approached super typhoon intensity, she reacted to a weakness in the ridge line and shifted to a more northwesterly component, thus aiming the storm at the southeastern peninsula of Luzon.

The cooler upper tropospheric environment of westerlies surrounding the typhoon's northern periphery served as a marked zone of contrast to the vast quantities of warm air being pumped out from the wall cloud region during this deepening period. The strong thermal wind effect in this area of merging air contributed to the production of an upper jet of westerly winds extending over a considerable distance. Evidence of the extensive outflow in existence on October 12th is depicted by the generation of a long band of cirrus stretching some 1,200 miles from Manila to Guam (see Figure 5-19). The narrow jet along the northern and eastern periphery of Joan was present as far east as Guam which reported at 200 mb west northwesterly winds of 50 knots.

The severity the typhoon had attained was testified to by an aerial reconnaissance crew which entered Joan before daybreak on the 13th. Upon penetration of the wall cloud region, the aircraft encountered severe turbulence accompanied by a "g" load force of 2.5. Once in the eye, the closed wall cloud topping above 35,000 feet gave a stadium bowl effect as revealed

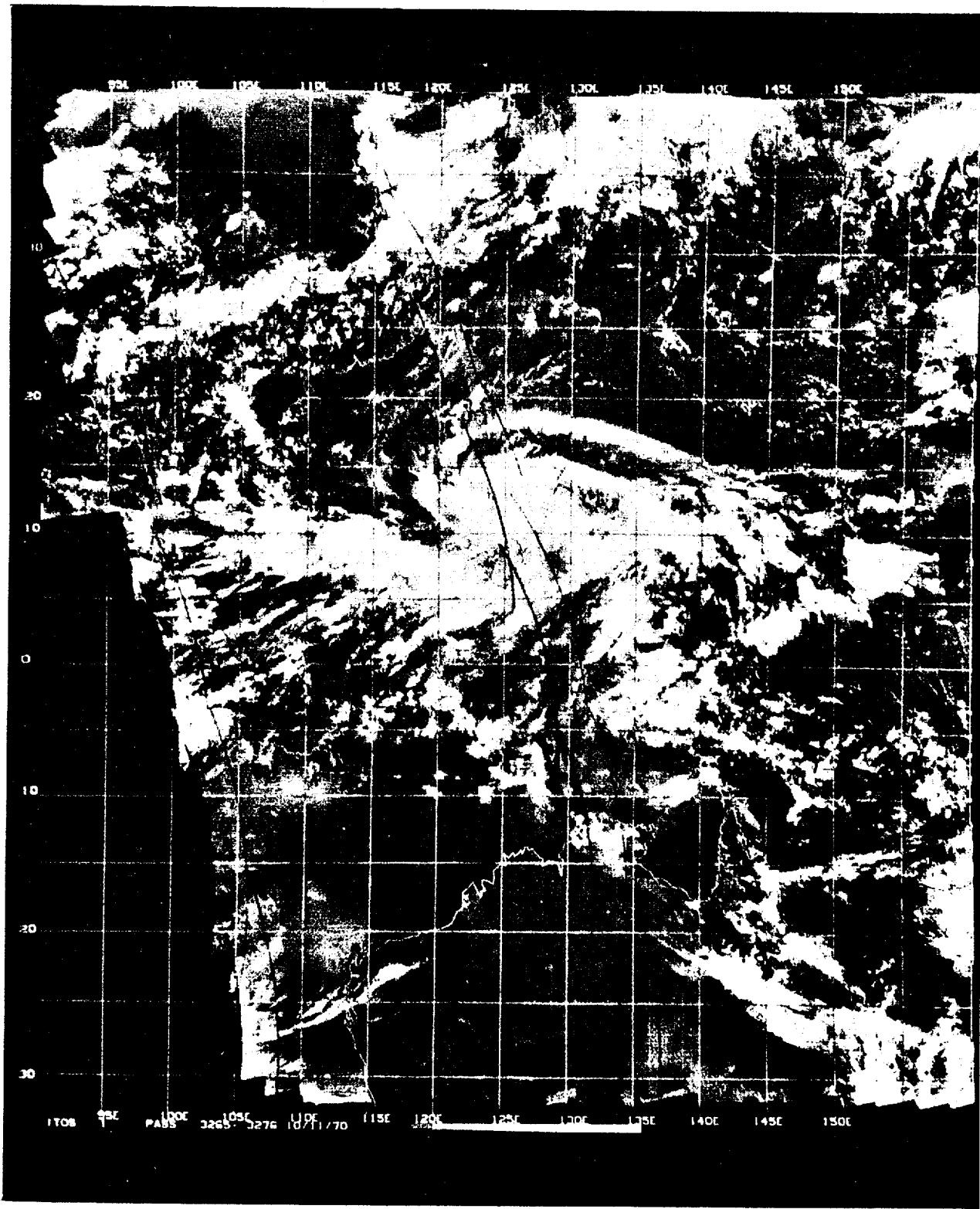


FIGURE 5-19 ITOS-1 MOSAIC ON 12 OCTOBER (LOCAL SUN TIME) DEPICTING EXTENSIVE CIRRUS BAND ON THE PERIPHERY OF TYPHOON JOAN'S OUTFLOW REGION.

by the continuous lightning occurring in all quadrants of the encircling coliseum. A dropsonde reading of 901 mb and max 700 mb temperature of 23.5°C was obtained while orbiting in the 25 mile diameter eye. Maximum surface wind occurring under the wall cloud region was estimated at 150 knots as daylight began. Looking for a weakness in the radar return to avoid further encounters with severe turbulence, the aircraft was forced to climb to 22,000 feet before exit was made. The temperature recorded at 500 mb during this climb was measured at +8.4°C.

Joan made landfall near noon in the Lagonoy Gulf region of southeastern Luzon after skirting the southern coast of Catanduanes Island. The U. S. Coast Guard loran station on the island, 30 miles north of the center, registered winds of 90 knots gusting to 110 knots before the anemometer failed. Lowest barometer reading was 973 mb. On the southern portion of the island the Philippine Weather Bureau station at Virac was heavily damaged but recorded a minimum sea level pressure of 950.7 mb and winds estimated near 150 knots.

The typhoon swept through the southern extent of Luzon moving across Bicol and Tagalog provinces and gradually losing strength. Passing some 20 miles south of Manila on the morning of the 14th, the International airport reported peak gusts of 84 knots and a 976.9 mb pressure reading while the Coast Guard vessel USCGC Blackhawk anchored in Manila Bay sustained gusts of 75 knots.

Upon her entrance in the South China Sea, aircraft fixes traced a cycloidal track during the 14th and 15th. The trajectory over rugged terrain of Luzon had disorganized the vertical structure around the central eye region of Joan. Apparently, the surface center was showing an oscillating behavior while embedded within a more stable upper center describing a uniform westerly track.

During this time frame, the area of gale force winds grew in size to more than 250 miles in radius from the center while the eye diameter expanded to some 80 miles. This area filled almost the entire northern half of the South China Sea ranking Joan as the largest typhoon in size in 1970 (Figure 5-20). The shipping traffic in this region felt its fury as at least one 390-foot vessel was in distress for over 24 hours.

A slow moving trough in the westerlies over Central China began to weaken the ridge line along 105-115°E on the 15th. This provided a path for a more northward component and Joan headed on a course toward the northeastern tip of Hainan on the morning of the 17th. It was of minimal typhoon strength and weakened considerably on passage up the Luichow Peninsula

slowly dissipating further inland over South China.

The typhoon left in its wake some 575 people dead and 1,590 injured, plus an additional 193 missing in the Republic of the Philippines. Damage was estimated near 74 million dollars (U.S.) with at least 80,000 people reported to be homeless and an agricultural crop loss of 92 percent in the region affected. These figures rank the storm high on the list of most destructive to affect that country.

5-79

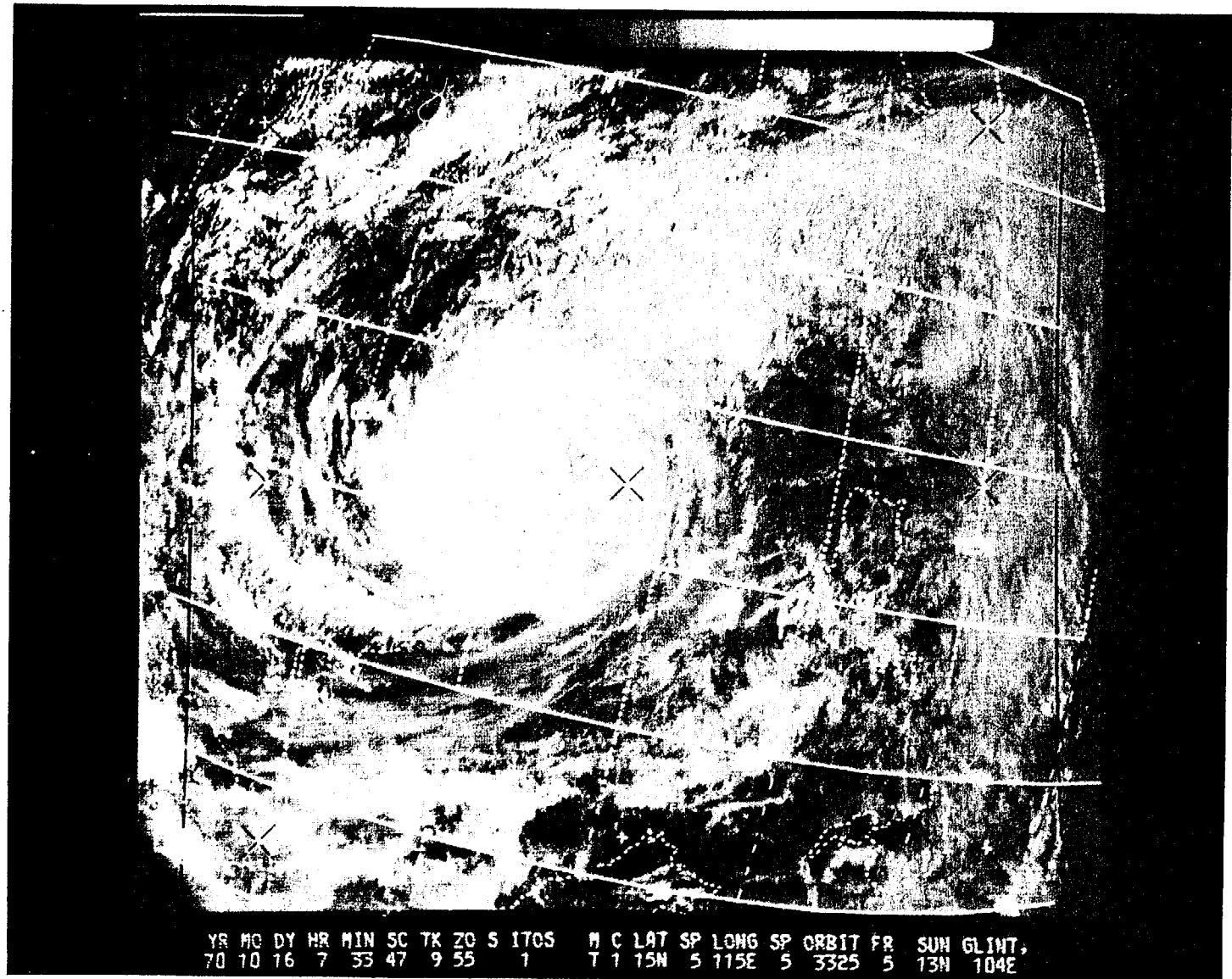


FIGURE 5-20 JOAN THE LARGEST TYPHOON IN SIZE DURING THE 1970 SEASON AS SEEN BY
CAMERA'S ABOARD ITOS-1 ON 16 OCTOBER.

TYPHOON JOAN EYE FIXES CYCLON

FIR NO.	TIME	POSTI	UNIT- MET-MOU -ACCY	FLT LVL	FLT LVL	SFC WIND	OBS AND SI.P	MIN 700MB	HGT	FLT FT/TO	EYE FORM	ORIEN- TATION	EYE DIA	CHARACTER	
														WALL	CLOUD
1	090450Z	09.0N 144.0E	SLTLS	STG B	DIA --	CAT -									
2	092345Z	09.5N 140.4E	54-P-15---	0500M	048	045	997	--	25/23	---					
3	100300Z	10.0N 139.6E	54-P-01---	700MB	048	035	996	3011	13/11	CIRC	---	10		W/C NE SEMICIR	
4	100546Z	09.5N 137.5E	SLTLS	STG X	DIA 04	CAT 2									
5	100600Z	10.3N 138.7E	54-P-05---	700MB	050	045	987	2987	13/10	---					
6	100846Z	10.6N 138.0E	VW-P-03---	0320M	---	055	993	--	21/23	CIRC	---	25		NO ORG W/C	
7	101447Z	10.8N 136.1E	VW-P-05---	0320M	---	055	990	3030	24/20	CIRC	---	27		WK W/C 6NM THK, OPEN NNE	
8	102100Z	11.0N 134.0E	54-P-05---	700MB	045	060	990	2996	14/08	CIRC	---	25		12NM THK, OPEN NNE	
9	110300Z	11.2N 132.3E	54-P-05---	---	060	070	976	2902	15/10	CIRC	---	25		OPEN NW-E QUAD	
10	110642Z	11.0N 132.5E	SLTLS	STG X	DIA 03	CAT 2									
11	110910Z	11.5N 130.7E	VW-P-03---	0430M	074	075	978	--	24/20	CIRC	---	15		3NM THK, WK S-W	
12	111100Z	11.6N 130.5E	VW-P---	---	---	---	---	---	---	---					
13	111200Z	11.7N 130.0E	VW-P---	---	---	---	---	---	---	CIRC	---	25			
14	111430Z	11.7N 130.1E	VW-P-10---	700MB	100	---	---	2908	12/07	CIRC	---	30			
15	112100Z	11.4N 128.4E	54-P-10---	700MB	092	---	959	2752	22/13	ELIP	N-S	27x22	SML BRKS IN W/C		
16	120300Z	11.4N 127.3E	54-P-10---	700MB	---	110	943 ³⁵	2615	20/11	CIRC	---	23		OPEN NW	
17	120530Z	11.5N 127.1E	54-P-10---	/ 700MB	068	120	938	2570	20/10	CIRC	---	25		CLSD	
18	120544Z	12.0N 127.0E	SLTLS	STG X	DIA 03	CAT 4									
19	120915Z	11.9N 127.0E	VW-P-07---	0270M	---	130	924	--	27/23	CIRC	---	16		CLSD 6NM THK	
20	121200Z	12.4N 126.7E	LND RUR	---	---	---	---	---	---	CIRC	---	25			
21	121400Z	12.4N 126.3E	VW-P-03---	---	---	---	---	---	---	CIRC	---	14		CLSD	
22	121600Z	12.8N 126.0E	LND RUR	---	---	---	---	---	---	CIRC	---	25			
23	121800Z	13.0N 125.7E	LND RUR	---	---	---	---	---	---	CIRC	---	30			
24	121900Z	13.1N 125.5E	LND RUR	---	---	---	---	---	---	CIRC	---	55			
25	122100Z	12.9N 125.2E	54-P-05---	700MB	110	150	901	2332	24/14	CIRC	---	25		CLSD 6NM THK	
26	122300Z	13.4N 124.6E	LND RUR	---	---	---	---	---	---	CIRC	---	30			
27	130000Z	13.5N 124.6E	LND RUR	---	---	---	---	---	---						
28	130200Z	13.6N 124.0E	LND RUR	---	---	---	---	---	---						
29	130300Z	13.6N 123.7E	LND RUR	---	---	---	---	---	---						
30	130330Z	13.6N 123.5E	LND RUR	---	---	---	---	---	---						
31	130400Z	13.6N 123.6E	LND RUR	---	---	---	---	---	---						
32	130500Z	13.6N 123.3E	LND RUR	---	---	---	---	---	---						
33	130500Z	13.6N 123.4E	LND RUR	---	---	---	---	---	---						
34	130530Z	13.5N 123.3E	LND RUR	---	---	---	---	---	---						
35	130630Z	13.7N 123.1E	LND PUR	---	---	---	---	---	---	---					
36	130640Z	14.0N 123.0E	SLTLS	STG X	DIA 04	CAT 4									
37	130803Z	13.8N 122.9E	LND RUR	---	---	---	---	---	---						
38	130858Z	13.8N 122.8E	VW-P-05---	700MB	050	---	---	2990	---	CIRC	---	10		BRKN, POORLY DEF	
39	131000Z	13.8N 122.7E	LND RUR	---	---	---	---	---	---						
40	131030Z	13.7N 122.7E	LND RUR	---	---	---	---	---	---						
41	131100Z	13.8N 122.6E	LND RUR	---	---	---	---	---	---						
42	131130Z	13.8N 122.5E	LND RUR	---	---	---	---	---	---						
43	131230Z	13.9N 122.4E	LND RUR	---	---	---	---	---	---						
44	131300Z	14.0N 122.3E	LND RUR	---	---	---	---	---	---						
45	131330Z	14.0N 122.2E	LND RUR	---	---	---	---	---	---						
46	131402Z	13.9N 122.2E	VW-P-02---	---	---	---	---	---	---	CIRC	---	09		POORLY DEF	
47	131500Z	14.1N 122.0E	LND RUR	---	---	---	---	---	---						
48	131730Z	14.4N 121.6E	LND RUR	---	---	---	---	---	---						

TYPHOON JOAN

FIX NO.	TIME	POSII	EYE FIXES CYCLONE			21	JDS	URS	MIN	FLT	LVL	TT/TO	EYE	ORIEN-	EYE	CHARACTER
			UNIF-	MET-OD	FLT		LVL	SFC	MIN	700MB	HGT	SLP				
49	131800Z	14.5N 121.5E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
50	131830Z	14.5N 121.4E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
51	131840Z	14.6N 121.3E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
52	131900Z	14.5N 121.3E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
53	131930Z	14.4N 121.2E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
54	132030Z	14.6N 121.0E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
55	132100Z	14.2N 121.2E	54-P-02---	500MB	050	---	---	---	---	2/6	CIR	---	---	18	CLSD, POORLY DEF	-----
56	132130Z	14.6N 120.7E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
57	140030Z	14.5N 120.4E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
58	140140Z	14.6N 120.2E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
59	140300Z	14.9N 119.6E	54-P-02---	500MB	040	080	968	---	2/4	CIR	---	---	25	REFORMG NE-W	-----	
60	140540Z	15.1N 118.5E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
61	140737Z	14.5N 118.0E	SLTLS	STG X	DIA 0	---	CAT 3	---	---	---	---	---	---	---	---	---
62	140830Z	14.8N 118.0E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
63	141000Z	14.5N 117.5E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
64	141200Z	14.1N 117.5E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
65	141212Z	14.1N 117.5E	LND	RUR	---	---	---	---	---	---	---	---	---	---	---	---
66	141239Z	14.2N 117.7E	VW-P-10---	700MB	---	---	2871	17/14	CIR	---	---	50	POORLY DEF	-----	-----	
67	141419Z	14.1N 117.6E	VW-P-04---	0500M	---	065	977	---	27/24	CIR	---	---	35	OPEN N-E-S	-----	
68	142115Z	15.1N 116.4E	54-P-15---	700MB	080	---	967	2838	17/14	CIR	---	---	40	OPEN E-W	-----	
69	150000Z	14.8N 115.8E	54-P-03---	700MB	065	065	966	2813	17/14	CIR	---	---	45	OPEN E-S	-----	
70	150200Z	14.5N 115.4E	54-P-03---	700MB	050	065	965	2813	18/15	CIR	---	---	40	OPEN N-SE	-----	
71	150830Z	15.1N 115.1E	VW-P-40---	---	---	---	---	---	---	---	---	---	---	---	---	---
72	150833Z	15.5N 115.0E	SLTLS	STG X	DIA 0	---	CAT 3	---	---	---	---	---	---	---	---	---
73	151404Z	15.4N 114.3E	VW-P-05---	---	115	125	958	---	24/22	ELIP	NW-SE	75x30	OPEN N	-----	-----	
74	152045Z	16.0N 113.3E	54-P-05---	700MB	085	---	952	2707	17/13	ELIP	NE-SW	80x50	BRKS NW-NE	-----	-----	
75	160320Z	17.0N 113.6E	54-P-05---	700MB	080	100	952	2704	21/13	ELIP	NW-SE	99x--	BRKN NE-SW	-----	-----	
76	160734Z	18.0N 112.0E	SLTLS	STG X	DIA 0	---	CAT 4	---	---	---	---	---	---	---	---	---
77	160900Z	18.0N 111.9E	VW-P-10---	---	060	055	---	---	---	---	---	---	80	25-35NM THK, OPEN NE-SE	-----	
78	161514Z	18.7N 111.8E	VW-P-15---	---	---	---	---	---	---	---	---	---	---	W/C S-N	-----	
79	170830Z	21.0N 110.0E	SLTLS	STG X	DIA 0	---	CAT 3	---	---	---	---	---	---	---	---	---

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TYPHOON JOAN

TROPICAL CYCLONE 21 -- 10/9/1700Z TO 10/18/0500Z
POSITION AND FORECAST VERIFICATION DATA

<u>WARN NO.</u>	<u>DTG</u>	<u>WARNING LAT</u>	<u>POSIT LONG</u>	<u>BEST LAT</u>	<u>TRACK LONG</u>	<u>24 HR FCST LAT</u>	<u>FCST LONG</u>	<u>24 HR ERROR DEG DIST</u>	<u>48 HR FCST LAT</u>	<u>FCST LONG</u>	<u>48 HR ERROR DEG DIST</u>	<u>72 HR FCST LAT</u>	<u>FCST LONG</u>	<u>72 HR ERROR DEG DIST</u>
01	09/2300Z	9.4N	140.6E	9.5N	140.7E	11.6N	134.6E	060-0066	13.2N	128.9E	024-0114	15.2N	123.5E	329-0126
02	10/0500Z	10.3N	139.0E	10.2N	139.0E	12.8N	132.8E	036-0102	14.6N	127.0E	358-0186	-----	-----	-----
03	10/1100Z	10.8N	137.3E	10.7N	137.3E	13.0N	131.1E	027-0090	15.0N	125.3E	335-0180	17.1N	119.9E	323-0240
04	10/1700Z	10.9N	135.4E	10.8N	135.4E	12.0N	129.0E	360-0030	13.9N	123.7E	298-0132	-----	-----	-----
05	10/2300Z	11.1N	133.4E	11.0N	133.5E	12.0N	126.4E	291-0096	13.7N	120.3E	275-0240	16.0N	115.2E	286-0312
06	11/0500Z	11.3N	131.7E	11.4N	131.7E	12.3N	125.1E	291-0126	14.2N	119.3E	278-0240	-----	-----	-----
07	11/1100Z	11.5N	130.2E	11.6N	130.3E	12.6N	124.1E	279-0150	14.4N	118.7E	279-0210	16.7N	113.9E	300-0258
08	11/1700Z	11.5N	129.6E	11.5N	129.1E	11.0N	124.8E	207-0120	12.0N	120.0E	214-0150	-----	-----	-----
09	11/2300Z	11.3N	128.0E	11.4N	128.0E	11.4N	122.5E	228-0168	12.7N	117.3E	240-0204	14.5N	112.4E	264-0198
10	12/0500Z	11.5N	127.1E	11.5N	127.2E	11.9N	123.1E	191-0102	12.7N	119.1E	180-0138	-----	-----	-----
11	12/1100Z	12.0N	126.8E	12.2N	126.7E	13.5N	124.0E	101-0090	14.5N	120.0E	090-0126	15.7N	116.0E	072-0072
12	12/1700Z	12.8N	126.1E	12.8N	125.8E	13.9N	122.4E	104-0048	14.9N	118.4E	090-0066	-----	-----	-----
13	12/2300Z	13.0N	125.0E	13.3N	124.7E	14.0N	121.4E	119-0060	15.2N	117.4E	078-0084	16.8N	114.1E	069-0060
14	13/0500Z	13.7N	123.2E	13.6N	123.5E	15.0N	118.8E	270-0012	16.5N	114.9E	345-0096	-----	-----	-----
15	13/1100Z	14.0N	122.3E	13.8N	122.4E	15.3N	117.9E	008-0048	16.6N	114.5E	355-0078	18.2N	111.6E	226-0012
16	13/1700Z	14.2N	121.6E	14.1N	121.5E	15.4N	117.6E	031-0030	16.8N	114.2E	020-0066	-----	-----	-----
17	13/2300Z	14.5N	120.6E	14.5N	120.4E	15.7N	117.0E	046-0066	17.0N	113.8E	050-0054	18.6N	110.9E	180-0066
18	14/0500Z	14.9N	119.2E	15.0N	119.1E	16.4N	115.1E	352-0090	17.9N	112.1E	348-0030	-----	-----	-----
19	14/1100Z	14.4N	117.5E	14.5N	117.8E	16.3N	116.3E	057-0108	17.9N	114.5E	101-0144	19.3N	113.1E	112-0174
20	14/1700Z	14.3N	118.0E	14.9N	117.2E	16.2N	116.5E	080-0162	17.7N	114.7E	114-0204	-----	-----	-----
21	14/2300Z	14.9N	116.0E	14.9N	115.9E	15.5N	112.1E	222-0072	15.5N	108.8E	207-0276	-----	-----	-----
22	15/0500Z	14.5N	115.2E	14.9N	115.4E	14.5N	111.7E	190-0174	14.5N	108.6E	199-0342	-----	-----	-----
23	15/1100Z	15.0N	114.5E	15.3N	114.7E	15.0N	111.0E	194-0204	15.0N	107.9E	202-0342	-----	-----	-----
24	15/1700Z	15.4N	114.0E	15.7N	113.7E	15.4N	110.7E	190-0222	15.8N	107.8E	200-0372	-----	-----	-----
25	15/2300Z	16.1N	113.1E	16.4N	113.0E	18.0N	110.1E	206-0108	20.0N	108.0E	239-0126	-----	-----	-----
26	16/0500Z	17.1N	112.2E	17.4N	112.3E	20.3N	110.4E	360-0018	23.0N	110.0E	-----	-----	-----	-----
27	16/1100Z	18.5N	111.7E	18.4N	111.9E	22.9N	110.8E	012-0150	-----	-----	-----	-----	-----	-----
28	16/1700Z	19.0N	111.8E	19.1N	111.4E	22.2N	112.1E	075-0108	-----	-----	-----	-----	-----	-----
29	16/2300Z	19.7N	111.6E	19.7N	111.0E	21.6N	111.5E	069-0078	-----	-----	-----	-----	-----	-----
30	17/0500Z	19.7N	111.4E	20.0N	110.5E	20.4N	110.2E	-----	-----	-----	-----	-----	-----	-----
31	17/1100Z	19.9N	111.1E	20.4N	110.2E	20.7N	110.2E	-----	-----	-----	-----	-----	-----	-----
32	17/1700Z	20.8N	109.9E	21.7N	110.1E	22.5N	108.8E	-----	-----	-----	-----	-----	-----	-----
33	17/2300Z	21.0N	110.2E	21.1N	110.0E	-----	-----	-----	-----	-----	-----	-----	-----	-----
34	18/0500Z	21.4N	110.1E	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

AVERAGE 24 HOUR ERROR - 0099 MI.
AVERAGE 48 HOUR ERROR - 0168 MI.
AVERAGE 72 HOUR ERROR - 0151 MI.

99.8